(12) UK Patent Application (19) GB (11) 2 065 011 A

(21) Application No 8038346
(22) Date of filing 28 Nov 1980
(30) Priority data
(31) 10608/79
(32) 29 Nov 1979
(33) Switzerland (CH)
(43) Application published
24 Jun 1981
(51) INT CL^3
B23K 9/20
(52) Domestic classification
B3R 2A 2B
F2H 17A2
(56) Documents cited
GB 1340085
GB 1288506
GB 1216943
GB 1129835
GB 974554
GB 960073
GB 778547
GB 689172
(58) Field of search
B3R
F2H

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(54) Studs for arc stud welding

(57) A stud for securing metal sheets, and composite panels with metal cover sheets, in place from one side only, in particular composite panels with a plastics core and cover sheets made of aluminium or aluminium alloys, is formed as a metal bolt with a shaft (10) and a head (20) whereby the head (20) carries a ring-shaped welding surface (26) on which a ring-shaped arcing ring (28) is provided. Both the welding surface (26) and the arcing ring (28) may be continuous or discontinuous. The element is joined to the metal cover sheet by condenser discharge welding.

Fig.1.

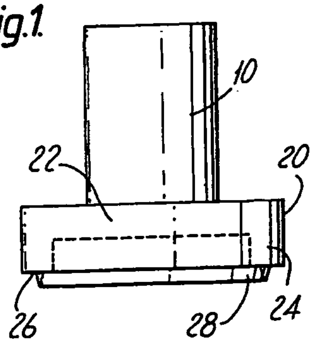


Fig.7.

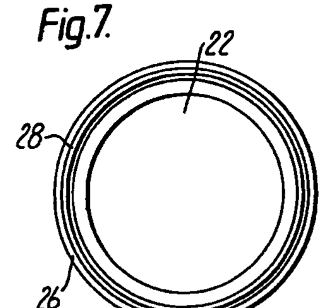
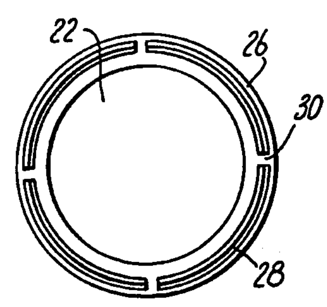


Fig.8.



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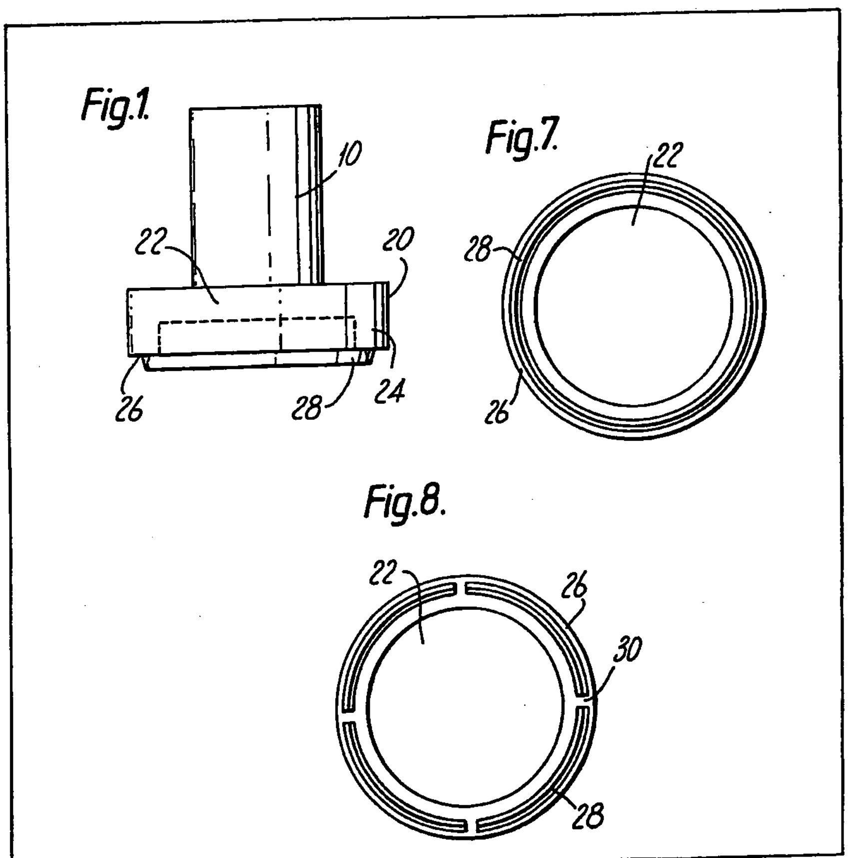

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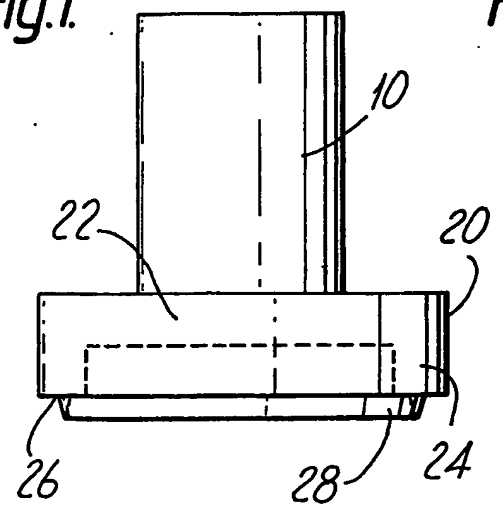


Fig.2.

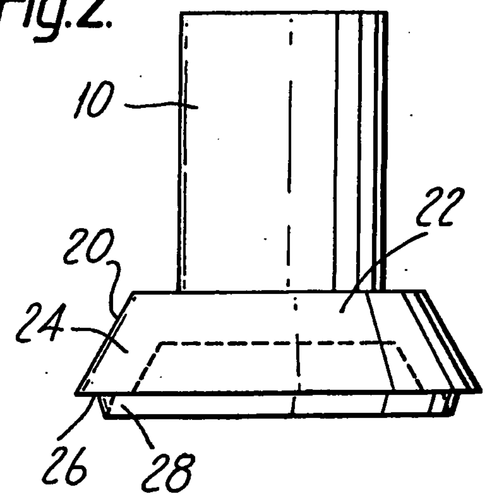
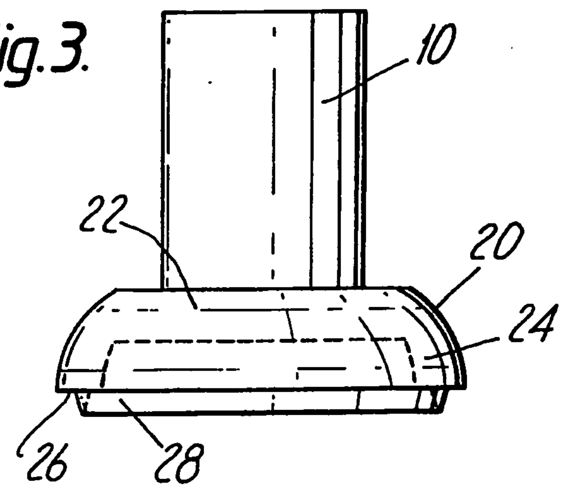


Fig.3.



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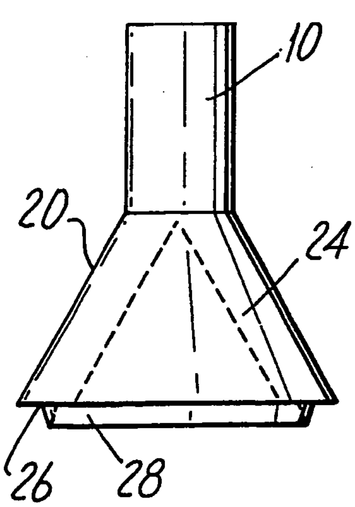


Fig.5.

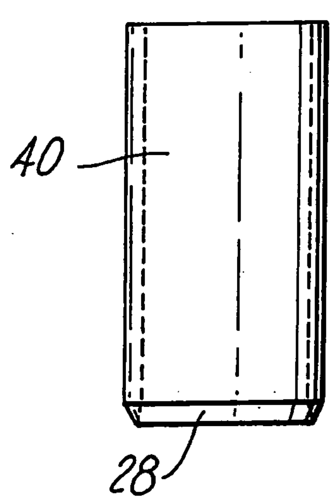


Fig.6.

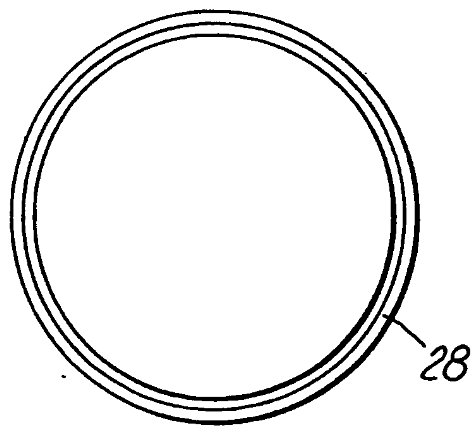


Fig.7.

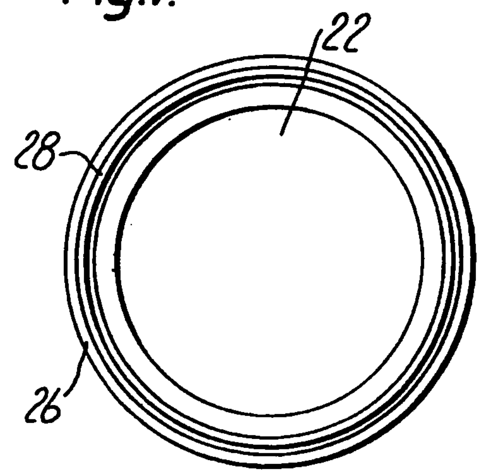


Fig.8.

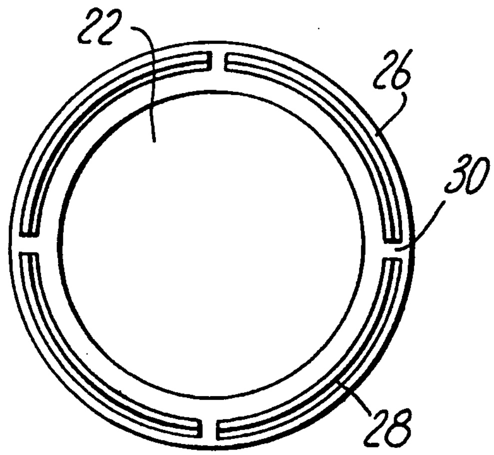
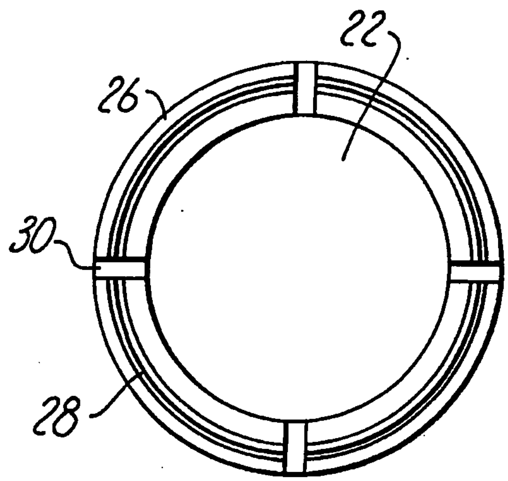


Fig.9.



SPECIFICATION

Securing elements

The present invention relates to elements for securing metal sheets, or composite panels having metal cover sheets, in place from one side only.

Composite panels, especially those with a plastics core and two metal cover sheets, are often mounted and secured in place from one side only. Especially when the panels are used as curtain walls there should be no deformation or features on the decorative, visible side due to the means for securing on the other side ie. nothing causing shadows or patterns which would detract from the aesthetic effect, in particular when the panel is illuminated by inclined lighting. However, also when the panels are used as room dividers, or the like, where the means of securing from one side are employed on each of the two sides, the means of securing the panel in place should again not detract in any way from the appearance of the panel on the other side.

Elements for securing composite panels in place from one side only are already known. However, they suffer from the disadvantages that they cannot guarantee a blemish-free appearance on the visible side, or they can be attached to the panel only by using uneconomic methods, or they are such that the strength of attachment is less than satisfactory. For example, when using the expandable claw according to German utility model 74 42 107 or the friction welding method according to Swiss patent 583 833, a hole must first be bored in one of the cover sheets. This markedly limits the load which can be borne by the joint and it also makes the method of mounting more expensive.

There has been no lack of effort to make an element for securing composite panels in place with the help of condenser discharge welding equipment. Up to now this method has brought no success as the resultant strength was too low, especially when the joint was subjected to torsional forces. This was due to the use of normal bolts having a concentric, slightly conical contact surface with a central shaft discharge point. Only with cover sheet thicknesses of more than approximately 1 mm was it possible to achieve results of even partial success. However, the cover sheets used are normally thinner than 1 mm. Neither condenser discharge welding nor any other method available up to now has provided a satisfactory method for mounting the commercially available composite panels.

The object of the present invention has therefore been to develop an element for mounting and securing in place metal sheets, in particular composite panels with a core of; for example, thermoplastics material and metal cover sheets, whereby the element does not feature the above-mentioned handicaps.

In their efforts to achieve the above objective, the inventors started from the observation that, in the case of bolts which are welded to a cover sheet, the deformation of the cover sheet depends basically on the size of the stresses applied to the bolt. When screwing on nuts the tightening torque, in which tension and torsion act simultaneously, is of great importance. When mounted as facade panels, for example, there are additional shear stresses which change depending on the weight or size of the composite panel and the number of supporting bolts. Also, thermal stresses due to changes in the ambient temperature act on the welded joint. It is therefore revealing that the manner in which the force is applied and the place where peak stresses occur are of decisive importance for the means used to secure the panel in place.

Surprisingly, it has turned out that by changing the geometric form of a conventional securing element, all the above-mentioned handicaps can be eliminated.

In accordance with the present invention, a securing element for use in securing metal sheets, or composite panels have metal cover sheets, in place from one side only by condenser discharge welding, comprises a shaft and a head, both formed of a metal, with the head including a continuous or discontinuous ring-shaped welding surface, which internally and externally has the shape of a closed conical section, and on which a continuous or discontinuous arcing ring is provided.

An advantage of securing elements in accordance with the present invention is that the welding does not proceed radially on one side, as with the bolts used up to now, but simultaneously inwards to smaller diameters and outwards to larger diameters.

Various securing elements in accordance with the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figures 1 to *5* are side views of five different securing elements; and

Figures 6 to *9* are end views of four different arrangements for the arcing ring of the securing elements.

As shown in Figures 1 to 5, it is convenient to regard a securing element according to the present invention as a metallic bolt which comprises a shaft 10 and a head 20 provided at one end. The shafts can, inst ad of being plain, be provided with inner or outer threads using generally known methods for this, or can feature some other means of securing. Unlike conventional bolt heads with an approximately 180° c nical weld surface and a central arc tip, the heads are provided with a welding surface 26 which is ring-shaped, the inner and outer limitations of which are characterised by a closed conical section. An arcing ring 28 is provided on the welding face 26 of each securing element according to the present invention.

Figure 1 represents a simple version of the invention having a head of pot-lik shape. More particularly, the head 20 comprises a circular base 22 on which a hollow, cylindrical-shaped ring 24 is mounted. The surface 26 to be welded to the sheet is of a continuous ring-shape and lies in a plane substantially vertical to the longitudinal axis of the shaft 10. The contact element to initiate the welding arc is a continuous,

preferably circular, arcing ring 28 located substantially in the middle of the surface 26 to be welded to the sheet.

In the course of development f the inventi n it was found that the ring 24 need not necessarily be cylindrical in shape. For example, blunted cone shapes or rounded versions such as are shown in Figures 2 and 3 also proved effective. With elliptical welding surfaces 26 it is advantageous for the ratio of the ellipse axes not to exceed about 3. Usually it is in the region of 1 ie. substantially circular. It also turns out that the base 22 can be omitted so that the ring 24, as shown for example in Figure 4, joins up directly to the shaft 10. As shown by way of example in Figure 5, the modification of the design can be taken so far that the result is a tubular bolt 40 in which the head 20 and the shaft 10 form a unit and can no longer be separately identified. A hole penetrates the whole length of the bolt 40 to form the inner limit of the welding surface 26. With such a bolt an outer or inner thread for example can serve to provide further means of attachment.

Figures 6 and 7 are end views showing that the arcing ring 28 can extend, respectively, either completely across the welding surface 26 or only partially across the welding surface 26, the location of the arcing ring in the latter case then being preferably generally centrally of the welding surface. The alternatives of Figures 6 and 7 can be applied to any of the forms of the securing element according to the present invention. In fact, it will be appreciated that Figure 6 can be regarded in the present case as an end view of Figure 5, with Figure 7 being an end view of Figures 1 to 4. Further alternatives, which are again applicable to any of the forms of the securing element according to the present invention, are shown in Figures 8 and 9. Here, the arcing ring 28, either along or in combination with the welding surface 26 of the ring 24, is provided with one or more slits 30 running approximately parallel to the shaft axis. These alternatives could also be applied where the arcing ring extends completely across the welding surface.

In a special version of the bolt the base 22 and the ring 24 are circular, and their outer diameter is 1 to 4 times, preferably 2 to 4 times, as large as the diameter of the shaft 10. Also preferred is that the thickness of the base 22 is 1 to 2 times the wall thickness of the ring 24, and the height of the ring 24 is about the same as the thickness of the base 22. The diameter of the arcing ring 28 is preferably half of the sum of the outer and inner diameters of the ring 24, measured at the welding surface 26, and the arcing ring 28 forms an isosceles or equilateral triangle, as viewed in cross-section, whereby the shorter side (if an isosceles triangle) lies in the plane of the welding surface 26 and the height is about one tenth of the diameter of the shaft 10.

With the securing element according to the present invention, much higher strengths of joint can be achieved than with the bolts used up to now for this purpose, as can be seen very clearly in the following table.

Crack formation or fracture of different types of bolt subjected to different kinds of loading

Type of bolt	Shear load	Tensile load	Torsion moment
(a)	766 N	455 N	27 cm/kp
(b)	1455 N	1028 N	57.5 cm/kp

The above values are the average values from 10 tests of each kind. The panel used was one which is commercially available, viz. 4 mm thick and made up of a 3mm thick polyethylene core with a metal cladding of 0.5mm thick, 1/4 hard alloy AlMgl on each side. The ultimate tensile strength of the cover sheet was 15 kp/mm^2. Both bolts were made of alloy AlMg3 and had a shaft diameter of 6mm. Bolt type (a) represents the conventional bolt with an 8mm diameter welding surface. Bolt (b) represents the bolt embodying the present invention and in the following preferred form: hollow-cylindrical ring 24 with an outer diameter of 12mm and height 3mm, whereby the wall thickness of the ring 24 was dimensioned such that the area of the circular ring of the welding surface 26 corresponded exactly to the area of the welding surface on bolt type (a). The arcing ring 28 constituted in cross-section an isosceles triangle which had an angle of 40° at the tip and had a height of 0.6mm.

In the case of the bolt type (a) the weld spreads out from a central arcing point where the first melting of the aluminium takes place. With this arrangement it is possible to achieve connections where 75 to 85% of the total surface is welded. As soon as the arcing ring 28 of bolt type (b) touches the cover sheet of the composite it is melted and the welding spreads, unlike the bolt (a), radially on both sides of the arcing ring 28. The result is a homogeneous weld connection with 100% of the total available surface welded.

The high strength of the weld achieved with the bolt (b) is presumably due to the fact that during welding, because of the short distance over which the w ld spreads acr ss the welding surface 26, the weld dross and other impurities can be driven radially inwards and outwards completely out of the weld zone so that the resultant weld formed is free of dross and/or inclusions of impurities.

The securing element according to the present invention thus overcomes the disadvantages experienced up to now, viz. the low tightening torque and the permanent deformation of the sh et on the exp sed side f the panel.

An additional advantage of the securing element according t the present invention is the better distribution of localised heating over a larger area of sheet, which with composite panels prevents partial, local separation of the cover from the core which could be caused by a high c ncentration of heat n one

spot, as with the use of conventi nal b lts.

The invention also extends to a securing lement according t the present invention which has been condenser discharge welded to a metal cover sheet (of for example aluminium or an aluminium alloy) of a composite panel including a plastics core.

CLAIMS

1. A securing element for use in securing metal sheets, or composite panels having metal cover sheets, in place from one side only by condenser discharge welding, comprising a shaft and a head, both formed of a metal, with the head including a continuous or discontinuous ring-shaped welding surface, which internally and externally has the shape of a closed conical section, and on which a continuous or discontinuous arcing ring is provided.

2. A securing element according to Claim 1, in which the welding surface is of an elliptical shape with the ratio of the axes not being greater than 3:1.

3. A securing element according to Claim 1, in which the welding surface is of a substantially circular shape.

4. A securing element according to any one of Claims 1 to 3, in which the arcing ring extends completely across the welding surface.

5. A securing element according to any one of Claims 1 to 3, in which the arcing ring extends only partially across the welding surface.

6. A securing element according to Claim 5, in which the arcing ring is located generally centrally of the welding surface.

7. A securing element according to any one of Claims 1 to 6, in which the arcing ring is continuous.

8. A securing element according to any one of Claims 1 to 6, in which the arcing ring, either alone or in combination with the welding surface, is discontinuous due to the provision of one or more slits.

9. A securing element according to any preceding claim, in which the shaft is formed as a hollow tube.

10. A securing element according to Claim 9, in which the head is formed as a hollow tube which is a prolongation of the shaft.

11. A securing element according to any preceding claim, in which the shaft is threaded.

12. A securing element according to Claim 1 and substantially as hereinbefore described with reference to any one of the accompanying drawings.

13. A securing element according to any preceding claim which has been condenser discharge welded to a metal cover sheet of a composite panel including a plastics core.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1981.
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